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PENSOFT

Direct observation of drifting juvenile seahorse *Hippocampus trimaculatus* Leach, 1814 beneath the offshore surface at Malacca Strait

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Abstract
Three drifting juvenile seahorses (100.3 mm, 89.5 mm, and 55.8 mm in height) were captured during 2 research surveys between shipping routes at Malacca Strait. All seahorse specimens were identified using morphometric data as *Hippocampus trimaculatus* Leach, 1814. This is the first direct observation of drifting *H. trimaculatus* seahorse near to the water surface, out of their reported water depth (10–100 m) and demersal habitats. This may provide evidence of translocation and long-distance dispersal of *H. trimaculatus* in the region.

Key words
Southeast Asia; flat-faced seahorse; dispersal mechanism; migration.

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Introduction

Seahorses are known to have wide geographical distributions; however, most populations show low genetic diversity, which is probably because these populations descend from a limited number of founders (Teske et al. 2005, Woodall et al. 2011, Zhang et al. 2014). This phenomenon is probably linked to their poor mobility trait, since all seahorses do not have caudal fins, but do have prehensile tails which allow them to cling on holdfast or bottom substrate (Lourie et al. 2004, Curtis and Vincent 2006). Allopatric barriers, ecological boundaries, and passive dispersal are among the proposed factors that could have shaped the distributions and speciation patterns in seahorses (Teske et al. 2005, Bowen et al. 2013, Luzzatto et al. 2014). Although there is growing number of new records of seahorse species in novel geographical regions (Woodall et al. 2009, Otero-Ferrer et al. 2015, Aylesworth et al. 2016), observations of migrating seahorses are rarely reported and their dispersive mechanism remains largely unknown (Luzzatto et al. 2013, 2014).

Methods

Seahorses were spotted incidentally and captured using a scoop net at <0.1 m depth during two different research surveys on 29 October 2014 and 15 September 2015, approximately 18 km off Port Dickson (Fig. 1). The geographic coordinates (GPSmap 76CSx, Garmin, map datum WGS 84) and environmental parameters during the first and second research surveys were recorded. Surface water temperature was 29.2–29.5 °C, salinity was 31–32 ppt, and water depth was approximately 32–35 m at the

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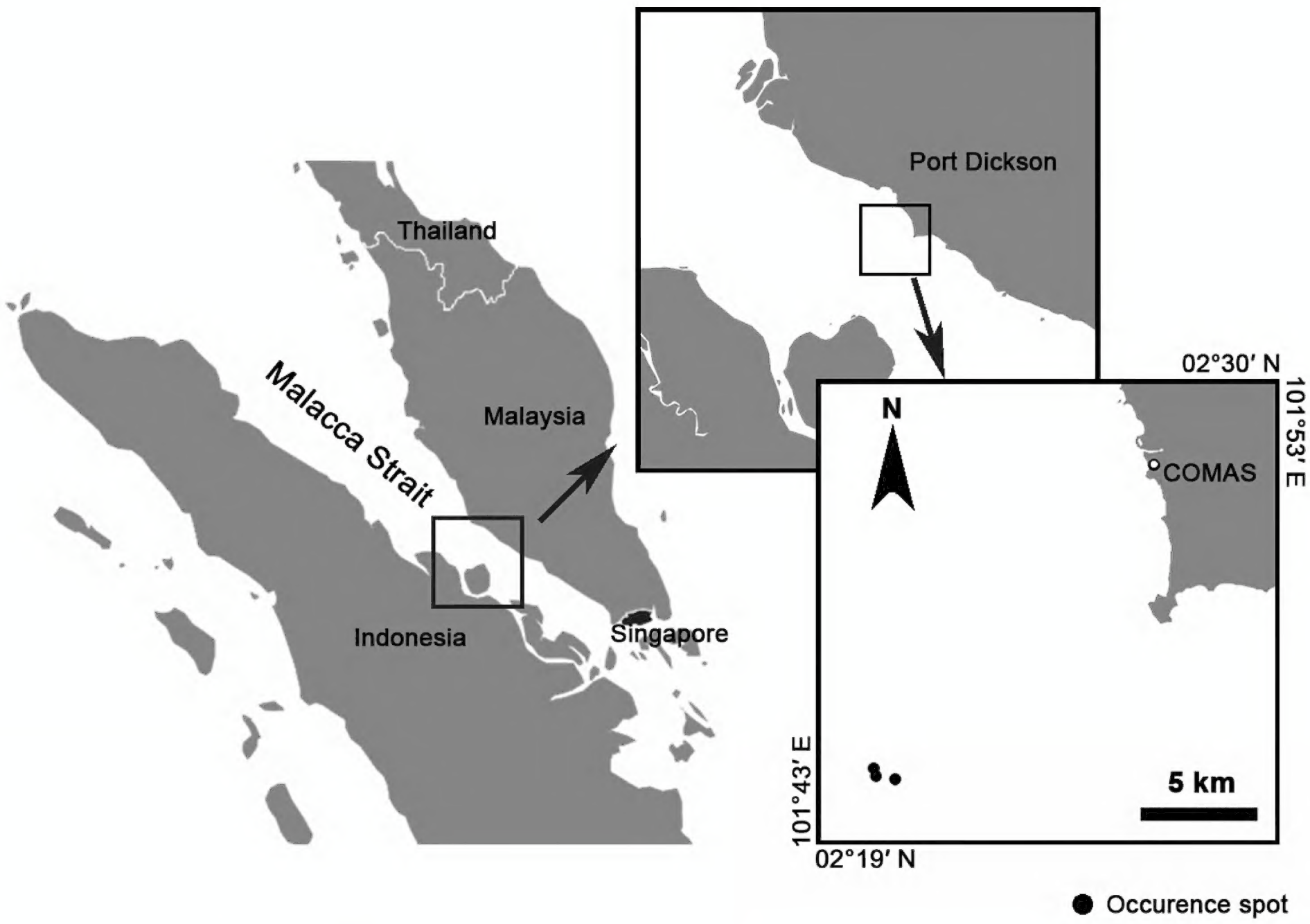

Figure 1. Occurrence locations of drifting *Hippocampus trimaculatus* juveniles approximately 18 km off Centre of Marine Science (COMAS), Universiti Putra Malaysia, Port Dickson.

survey area. The collected seahorses were kept alive in a 10 L bucket filled with seawater. A substrate made of nylon strings attached to a small stone was provided. Seahorses were transported back to Centre of Marine Science (COMAS, Universiti Putra Malaysia) where morphological analysis and identification of seahorse specimens were done following the methods of Lourie et al. (2004).

Results

Hippocampus trimaculatus Leach, 1814

Hippocampus trimaculatus Leach, 1814: 104—Lourie et al. (2004): 80.

Material examined. Table 1; Figure 2

Three juvenile seahorses were collected. All specimens lacked spikes, or spines, on their body. The low coronet, hook-like cheek spine, and eye spine served to distinguish specimens of *Hippocampus trimaculatus* from other large and smooth body seahorses (i.e., *H. kelloggi* Jordan & Snyder, 1901 and *H. kuda* Bleeker, 1852), which are also present in Peninsular Malaysia.

Hippocampus trimaculatus juveniles were found drifting beneath water surface off shore without attachment to any floating debris. For the first time, such behaviour was observed and recorded among *H. trimaculatus*.

Discussion

The three-spot or flat-faced seahorse *H trimaculatus* is known to have a wide geographical range in tropical and sub-tropical waters including Japan, China, India, Southeast Asia, northern Australia, and likely extending to Papua New Guinea, Bangladesh, and Sri Lanka (Lourie et al. 2004, 2005). This species is commonly obtained from trawl bycatch and sold dried for Traditional Chinese Medicine (Perry et al. 2010, Lawson et al. 2015, Yip et al. 2015). Despite limited information on their life history traits and populations, analysis of international trade data has indicated a tendency of overharvest; the populations

Table 1. *Hippocampus trimaculatus* specimens recorded during research surveys at the sea of Malacca Strait.

	Specimen 1-1	Specimen 2-1	Specimen 2-2
Date	29 October 2014	15 September 2015	15 September 2015
Location	02°20′25.2″ N, 101°44′47.5″ E	02°20′38.8″ N, 101°44′17.3″ E	02°20′32.1″ N, 101°44′20.2″ E
Size (Height)	100.3 mm	89.5 mm	55.8 mm
Brood pouch	Yes	No	No

Figure 2. *Hippocampus trimaculatus* juvenile (Specimen 1-1) with a brood pouch. Scale bar: 20 mm.

of *H. trimaculatus* are declining in an alarming trend (Perry et al. 2010, Wiswedel 2015).

Hippocampus trimaculatus is usually found in deep waters (10–100 m depth) with muddy bottoms (Lourie et al. 2004, Wiswedel 2015). Many *H. trimaculatus* adults (120–191 mm height) and juveniles (63–110 mm height) captured by trawl vessels along Malacca Strait have been recorded, and these trawlers supposedly operate at least 9.3 km (5 nautical miles) away from shore at approximately 20–50 m depth (Yip et al. 2015). In this study, one of the *H. trimaculatus* specimens possesses a brood pouch, but it was considered as a juvenile since its height was less than 120 mm, according to Yip et al. (2015). Although seahorses are not active swimmers, it has been suggested that *H. trimaculatus* species may have a high dispersal capability and undergo habitat shift or translocation (Lourie et al. 2005, Zhang et al. 2014). The direct observations of *H. trimaculatus* juveniles near to surface (<0.1 m) of deep water in this study was likely the first drifting juvenile seahorse ever recorded along Malacca Strait and this could be a strong evidence for the passive long-distance migration in young *H. trimaculatus*.

Moreover, the size variations among the drifting *H. trimaculatus* juveniles found in this study was high, and in fact, the size range was overlapping with those juveniles that have been collected from deeper water (Yip et al. 2015). These findings indicate that the drifting behaviour of *H. trimaculatus* juveniles may be passively induced by external factors such as food availability, environmental changes and habitat disturbance, despite their circadian rhythm. Similarly, *H. patagonicus* Piacentino & Luzzatto, 2004 juveniles have been reportedly rafting with floating debris in the northeast Atlantic Ocean (Luzzatto et al. 2013). Although there were floating debris and suspended solids observed nearby, the drifting *H. trimaculatus* juveniles were curled up with head lowered and not attached to any object when found. Information obtained from this study is likely to contribute towards a better knowledge of the dispersive mechanism, life history, and behavioural traits in *H. trimaculatus*, and perhaps more sophisticated conservation measures can be developed particularly for this seahorse in Malacca Strait.

Authors' Contributions

NLWSW collected and documented the specimen occurrences. JCT identified and photographed the specimens. Both authors wrote, read, and approved the manuscript.

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